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A lifeline and a reason to be: the future of sustainable architecture in Spain and its European context

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Abstract

Background: Architecture and construction in Europe have felt, like few other sectors, the consequences of the financial crisis that set in during 2008. This is only a logical result of their enormous dependency on different kinds of resources (financial, material, energetic). The outcome of these events can be interpreted within a general urgency to establish more sustainable patterns of life and this leads us to analyse the shifting paradigms that society applies regarding the appreciation of building performance. This affects Spanish architecture specially, since both the causes and the effects of this traumatic transition have been very prominent in this country.

Methods: Through the comparison of different phenomena that affect architecture in a more or less direct way tendencies can be discerned, on what will be defining architectonic criteria in the years to come. A description of these heterogeneous interfering aspects establishes a preliminary approach to interpret the Spanish situation, for which then more specific examples are listed. After having recognised a series of sustainability themes, which society takes into account generally, they are being extrapolated to the field of architecture.

Results: The interpretation of social and economic phenomena as conditioning circumstances for the creation of architecture is a first step to apply the forthcoming logics to the profession. After this, a coherent set of results generates new objectives, which mark a way for the profession to become meaningful from the point of view of a scarcity of resources, covering simultaneously economical and ecological aspects. Examples from legislation and reports confirm this arising framework for the Spanish context.

Conclusions: Answering the questions that society poses to architecture implies taking a stand in the rapidly developing discussion on sustainability and for this Spanish architects have an important series of tools to their disposal. It is paramount nevertheless that the lecture of the new situation in which they have to work, takes into account the various conditioning aspects combined with a coherent interpretation of their effects. Thus a new social legitimization of architecture can be established.

Introduction

In his book (European Architecture since 1890) Dutch architecture-critic Hans Ibelings describes how architecture in Europe, throughout the twentieth century, has been one of the most important vehicles for cultural expression… until the economic crisis of 2008 set in, that is… After an encyclopaedic analysis of architecture production throughout all Europe[a], – the sting is in the tail - he announces that the impact of architecture on our societies will be considerably smaller in the coming future; due to the huge amount of buildings that has been erected in the last decades, due to demographic tendencies and due to a lack of economic momentum. Since these words were written in 2011, Europe might have been able to overcome the worst of the economic crisis, but as far as architecture is concerned, the ailment is long from over and Ibelings prediction seems to turn out to be true, at least for the moment.

Focusing on architecture in Spain is confronting. Who remembers still the 2006 exposition in the New York MOMA where Spanish architects were heralded? Or Santiago Calatrava being selected to design the prestigious project for the transportation hub at Ground

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Zero? Little glamour is there to be found nowadays in Spanish architecture[b] and there exists a general awareness, that the profession requires a new legitimization.

Now some light has already been cast upon what the future beholds, and modesty, efficiency and sustainability are important issues within this new framework. They respond to a situation, in which the profession will have to confront not only a crisis of economic resources, but also a crisis of natural resources, that will be even more persistent.

The shift of paradigms and the changing conditions that architecture has to deal with, were commented on during the seminar '*The Context of Sustainable Architecture*', which was held in Barcelona in May last year[c]. Then in October, in the same city but from a more global perspective, these tendencies were confirmed at the World Sustainable Building Congress 2014[d]. There it was stated explicitly that it is paramount for architects to position themselves in a rapidly changing landscape, where scarcity is an important issue. Although it seems clear, that the architecture will be defined by parameters that reflect this radically new context, for the moment it seems that architects are having a hard time getting a thorough grasp on these new circumstances.

Sustainability criteria

There is a clear tendency, amongst the whole building community, to calculate with increasing precision the ecological footprint of construction, using elaborated software and a growing number of so-called 'rating tools'. A first generation of these (LEED for example) has increased consciousness but later on they have come under scrutiny for not being precise when applied in different contexts. In Europe different specific tools have been developed in order to evaluate the environmental impact of projects being erected within its territory. Sometimes these tools are comprehensive, taking into account also social and economical issues (people-planet-profit), some of them consider all technical aspects of construction (BREEAM, DGNB) and others limit their scope voluntarily to one aspect, like for example energy (Minergie, PassivHaus). In parallel to these voluntary rating-systems, and often under the umbrella of the European Commission's Roadmap 2050[e], more and more national and local administrations are imposing their own obligatory benchmarks and legislation. Against this background the need for detailed and adequate quantification is increasing[f].

Now that there exists some general consensus on the evaluation criteria chapters (energy consumption, water use, pollution, waste, effects on transportation, biodiversity etcetera…) the importance of each of those issues and their mutual relations are being measured differently in different systems. This complexity will only increase as also large scale projects and circular processes will be incorporated. This will surely make the understanding of its functioning for non-technicians more complicated but it will improve the rigour of the determination of the ecological footprint of building.

With all this measuring, 'green-washing' is becoming more and more difficult, as the awareness and knowledge amongst architects, journalists, developers and the general public is growing. Disenchantment with fake 'green-buildings' is provoking a harsh debate about what is really sustainable and what is just being advertised as such. Since 'green' has become 'cool', architectonic marketing has embraced values like auto-sufficiency, organic forms and other suggestive paraphernalia that supposedly represent a reduction of the ecological footprint of projects, in many cases completely unjust.

A flagrant example of these practices was seen in the southern Spanish region of Andalusia, where the national secretary of state for the environment handed out in 2013 a 'sustainability-award' to the owner of a restaurant built on the Matalascañas beach (http://elpais.com/elpais/2013/10/10/inenglish/1381407299_017264.html). Its construction was in clear violation of national environmental laws (and denounced as such), for being located in a protected maritime area where any new construction was prohibited. Nevertheless the owner was interested in obtaining an award for being 'the greenest in town'. And he got it. Separating waste, using LED-illumination and controlled water discharge was enough in this case to be the called the winner. One strange thing is obviously that a national administration hands out an award under these circumstances. But even more interesting (surprising, worrying…) might be the fact that an entrepreneur, lacking sincere environmental interest, does have a desire to promote himself as 'green'.

A more famous example of doubtful 'green building marketing' is Norman Fosters project for Masdar-city in the united Arab Emirates. It has consistently been presented by its promoters as completely sustainable but at this moment there is in almost every publication of it at least some kind of sceptical note included. 'How sustainable can the construction of a whole new city in the middle of a dessert be, regardless of the hectares of PV-installations that come with it?'.

Although there is undoubtedly still a long way to go before the last unrighteous eco-award has been handed out, a tendency towards a rigorously critical attitude is evident and Sustainable Building rating-tools are helpful in this aspect. While construction itself is still dragging its feet, software, academic education and innovative technologies are responding to this growing demand for precision.

Energy

The only way to mitigate to some extent the ongoing process of climate change will be the radical shift away

from the generation of energy from fossil fuels and towards a combination of energy efficiency with renewable and low-carbon energy sources. A lot of numbers have been mentioned by a great many of sources, explaining either the feasibility of the 'Energy transition' or the impossibility to realise its goals. Elaborating on precise quantifications and the rejection of idle publicity, the study '*Renewable energies without the hot air*' (http://www.withouthotair.com) by English professor David MacKay has absolutely helped to distinguish realistic goals from false claims surrounding the global energy-transition that is unfolding before our eyes. MacKay, who was until September 2014 chief scientific director at the Department of Energy and Climate Change of the British government, wrote this document while lecturing at the University of Cambridge, and in the first pages he states that if everybody contributes his little bit, in the end we will only achieve a little bit. This is his starting point to determine where we should concentrate our efforts in order to be really effective in CO2 reduction in relation to energy consumption and generation.

MacKay then defines all whole list of 'energy battlefields', that goes from transportation and consumer goods to new technologies and food. As far as architecture and urbanism are concerned, there is obviously a great responsibility awaiting both professions. He describes the necessity of a clear push towards the reduction of energy demand in buildings, combined with a creative effort to create a substantial supply from renewable energy sources in these very same buildings. And more or less the same goes for urban environments, where at the same time transportation and 'smarter' energy grids are able to do more with much less KWh, and the possibilities to generate renewable energy on an urban scale are also growing while storage technology is progressing.

Increasing energy prices because of international dependency have already been at the root of geopolitical decisions like the German 'Energie-wende' and the USA claim to energy auto-sufficiency. But also on the scale of house owners and real estate tenants the economic necessity of energy-efficiency is becoming more and more evident. Meanwhile energetic auto-sufficiency has come, according to the building typology, within reach of many house owners.

The desire for low-energy/passive houses, for efficient installations, and for renewable energy generation on site are by now generally considered as normal and its initial costs are seen as a feasible investment. This doesn't necessarily mean that buildings will all become 'net-zero'[g], especially not within dense urban fabric, but an overall tendency is easily recognized.

The common interest that is shared by developers and users to reduce need for external energy supply to buildings is where the architect should be able to contribute essential knowledge, satisfying a demand that is clearly incrementing in the market. Increased awareness and responsibility from his side towards the costs of exploitation should also be considered as 'lessons-learned' from the technical negligence that marked the glorious years of the real estate bubble. In those days little consideration was given to the consequences of inefficient design (even by the developer), both in the economical field as from a simple point of view of inconvenience. But that has changed drastically. From a broad perspective the simultaneous advances on the scale of buildings and of cities may cause a serious fall in energy-demands in urban areas in Europe on the middle-long term.

Rehabilitation

Another phenomenon, related to sustainability, that will drastically influence the daily practice of architecture studios throughout Europe is the fact that new construction will not get back to levels comparable to before 2008. This may be partly compensated by an increase in renovation and rehabilitation projects, which responds to a general tendency in our society not to replace but to re-use and re-cycle commodities. But it might also go beyond that and lead to extreme scenarios, like the process that is taking place actually in the southern part of the Netherlands, in the so-called 'Parkstad' region. There the ongoing demographic population decrease has caused not only the demolition of obsolete housing blocks but even the disappearing of entire streets, like the Govert Flinckstraat in the city of Heerlen, where housing corporation Woonpunt demolished several housing blocks entirely. It is nevertheless a task of architects and urbanists to guide these processes[h] that take place without any demand for new construction.

Since the 1960's a lot of buildings have been built that can still serve, as far as their load-bearing structure is concerned. The system of concrete pillars and free floor-fields that is typical for this period generates a high level of flexibility. These constructions are not fit to be demolished but they need retro-fitting and/or interior re-distribution. Sometimes this is even valid for relatively young buildings (1990's !!), as many of them suffer from poor energetic performance according to new standards and at the same time from deficient technical quality; a side effect of the hurries of building during the real-estate boom.

Not only the excess of existing under-performing buildings but also the aversion that has come about in Europe towards sprawl and ever-extending urbanised areas, will definitely confirm the shifts in the role of the architect in this aspect. He will be concentrating on the improvement of present urban areas instead of creating newly built environments. Increasing density, complexity and compactness in cities will be the big-scale variant of renovating houses. That also will be an expression of

enhancing sustainability, now through the reduction of transportation, higher efficiency, more social cohesion and less land occupancy.

This new panorama will confirm the reduced cultural importance of architecture, as the imperative of the engineering part will have its effect on the conceptual essence of architectonic projects. But opposed to this reduced cultural role, the question on the social and economic relevance of architecture is still an open one. A traumatic loss of cultural interest might be compensated by a more solid socio-economic legitimatization[i]. But how thorough this transformation of the profession will be and whether architects will be able to fill this niche, depends on their ability to re-position themselves amongst the other players of the construction sector. Constructors and engineers are adapting already, in their own pragmatic ways, to the new kind of commissions they will encounter. Probably a whole new business model will emerge, with a new scheme of services offered and of responsibilities assumed. This affects developers, managers, architects, engineers and constructors all at the same time.

Strict financial conditions will more than before define the value of architecture but what will shape the new social role of the profession? Already at the end of the nineties the Dutch architect Hans van Heeswijk renovated high-rise housing slabs in the city of Zaandam and lately the rehabilitation project for a social housing block in the outskirts of Paris by Lacaton-Vassal has been used as an example of what will become a standard assignment. Both projects confirm that a less aesthetical and more technical approach will be asked for. So long Jean Nouvel,… welcome back Jean Prouvé.

Industrial re-utilization

As concepts like *Cradle-to-Cradle* (Braungart and Editorial McGraw 2005) and Circular Economy are proving that they are here to stay, showing that they are more than a manifesto and a theory, architects might very well make sure that they are aware of the implications of these principles on their profession. These go beyond the idea or reusing a building as a whole and they will also be applied to the parts of it. An understanding of the life-cycles of the different elements that constitute a building is therefore needed and this requires a more industrial-analytical perception of the 'product' that a building is.

A far as building industry is concerned, its big dependence on and the scarcity of natural resources, like water, wood and concrete (steel is already being recycled in large amounts) obliges companies to find ways to reduce their demand. Obviously there is the way of efficiency through industrialisation, causing both considerable waste reduction and a smaller necessity of primary materials. This sophistication and the plain recycling (of steel, aluminium, concrete gravels and other materials coming forth from demolition) are trends that the construction sector is integrating already into its working processes and business models.

The most far-reaching consequences of the implementation of these concepts might come when companies can guarantee that they themselves will take care of the recuperation and recycling of the products they supplied in the first place. In this business-model they do not sell, but rather 'lease' their products and the owner of the building where there are 'integrated'[j], basically agrees that the provider will get them back after some years. Plainly said, this would avoid the creation of waste by the 'consumer' of buidling elements.

The best example of this is the world's number one carpet producer, Interface, whose modular carpets can be returned to the company, in order to let it break down the tiles and recycle the material for the creation of new ones. Also Spanish firm, ROSA Gres, is starting to apply this model with their ceramic tiles. The way these companies take on new tasks, like maintenance and liability issues that come with the fact that they remain the 'owner' of the carpet, transforms an enterprise that sells products with a certain period of guarantee, into a provider of services. This is, especially for an archaic sector as construction, a drastic change and as a matter of fact by now it isn't completely clear what all the implications of this model are, especially in the legal field. From an entrepreneurial point of view it is intriguing to think of what more might come from these new business models when they are applied to buildings because the value of elements and resources to be recuperated after a certain life-span might be impressive.

If the problems surrounding the issue of recycling up until now have been due to, at least in part, the complex relationships between provider, customer and recycler, the fact that provider and re-cycler become one and the same is fundamental. It establishes a clearer chain of supply, in which the one that produces is also the one that gets the benefits of the recuperation of material. That is attractive because he is also the one that has the capacity and machinery to transform this 'waste' into 'nutrient', as MacDonough and Braungart say in their book. If the architect tries to be aware of the life-spans of the different elements that go into his design, he can either consciously create the possibility for re-cycling of parts, or he condemns the building as a whole to an early demolition.

One should keep in mind nevertheless, that the application of cradle-to-cradle design and the specific example of Interface have its roots in the necessity to be more sustainable, not only from an economic but above all from an environmental point of view. The final objective of this development should be a drastic reduction, not to say annihilation, of the extraction of natural

resources. This can translate in a serious reduction of the ecological footprint of our buildings, once architects succeed to consider them organisms, that are able to change over time.

Spain, now and in the future

That the status of architecture has come under pressure and that even its social relevance has been questioned, once the real-estate bubble busted, was to be expected. The huge amount of prestigious and sometimes directly useless public buildings that have been erected all over Europe, has been a very powerful argument for those that discredited architecture as a whole. Nowadays architects, be it out of necessity or out of conviction, are assuming more down-to-earth assignments and new tasks. The changes in the circumstances under which architecture comes into being are tremendous in technical, economical and conceptual aspects, as I have explained above. This places architecture in a position where its relative autonomy, that was cherished during more or less the last two decades, has become unsustainable. The endogamy of architecture referring in the first place to architecture itself is not acceptable anymore for the general public, and also not for public governors. Architecture will have to relate more to its context than it has done in recent years.

Now where does Spanish architecture stand in this evolution and at this very moment? Spain has been at the peak of prestige and it has seen the depths of the valley of misery. It's excess in building stock is still enormous, its economy still dragging and for these and other extreme circumstances[k] it is of course interesting to observe how precisely this architects-collective responds to the shifting paradigms. The situation is complex; not only as far as the attitude of architects themselves is concerned but also when we take into consideration precisely the context of the profession.

Apart from the ROSA-Gres example, at a corporate level there is little movement in this direction and the conservative tendencies of big powerful construction companies, contaminated by the typical inertia of the sector, are still hard to overcome. One does see however, that small and medium scale enterprises are developing new initiatives applying industrialised technologies and, for example, the application of wood as a main construction material. Because to the ferocious dominance of the brick and concrete sector, this was unthinkable until recently.

Interesting is the role of different administrations, trying to impulse sustainable policies in spite of little coherence throughout the various levels of government[l]. Local entities may be quite progressive in this aspect but the bigger the distance to the citizen, the bigger the influence of established interests. This is obviously one of the reasons that a very controversial law-draft was accepted by Spanish parliament, regarding the generation and sales of solar energy to the utilities operating on a national level. This law would oblige people that have a PV-installation at their home to pay to before they can start selling their energy to the utilities, making the investment for these green-energy installations unfeasible for many private households. Coming at the time when many countries are promoting precisely such small-scale de-centralised installations, this bill has been criticised heavily and internationally (http://www.forbes.com/sites/kellyphillipserb/2013/08/19/out-of-ideas-and-in-debt-spain-sets-sights-on-taxing-the-sun/). On a national level it has casted doubts over new renewable energy initiatives and thus stagnated their realisation. Nevertheless it might very well be that in the end the draft will not be accepted during the present legislation period, which makes also its definitive acceptation highly uncertain.

Meanwhile (and in some way surprisingly) that very same Spanish parliament has also accepted the so-called 'Law of the three R's', dealing with the Rehabilitation, Regeneration and Renovation of urban areas (http://www.boe.es/boe/dias/2013/06/27/pdfs/BOE-A-2013-6938.pdf). This law marks a clear shift away from the unlimited generation of new urban territory, which was the main motor of the Spanish real-estate bubble in the first place. It favours and facilitates the generation of activity and investment in existing urban areas. The lack of maintenance over there has affected precisely areas that could have showed resilience during the crisis, in view of the socio-economical strength that is inherent to a solid and established urban fabric[m].

So while at an administrative level the results are mixed, the biggest progress towards a more sustainable architecture and construction sector in Spain is to be found at the level of professional associations and entities concerned with sustainable building and like-minded academic institutes.

The development and introduction by the Green Building Council España of a specific Spanish rating-tool for sustainable building, VERDE, has been a serious endeavour in this aspect[n]. Obviously does it respond to local realities but more than this its main virtue resides in the fact that it establishes a matrix reflecting and measuring the consequences of different design decisions. This means that one single decision is contemplated to have multiple effects on different levels of the final evaluation, which pretends to include the whole life cycle of the building. It makes the tool a lot more complex and less accessible than for example LEED, which is structured as a simple checklist[o]. But it is more precise as a measuring of the ecological footprint of a project and its outcome reflects a lot better the consequences of construction.

Another outstanding initiative has been the edition of the document *Towards a New Construction Sector in Spain* (http://www.gbce.es/en/pagina/gtr-2014), written

by economist Peter Sweatman and architect Albert Cuchí for the CONAMA Foundation and (again) the GBCe. In an merciless way the writers show their readers where economic possibilities will exist for architecture and construction projects, taking into account the exiting real estate stock in Spain and its technical conditions, which can be considered as highly deficient. They calculate how much there is to be saved through energy-renovation of dwellings and they argue with rigorous numbers that this will be the main financial motivation for house-owners and developers to start up new projects. They conclude saying that there can be a future for a construction sector in Spain, a fact that some came to doubt.

This document has also lead to a positive appreciation of Spain in the evaluation of ten EU-member states by the Buildings Performance Institute of Europe (http://bpie.eu/uploads/lib/document/attachment/86/Renovation_Strategies_EU_BPIE_2014.pdf), regarding their compliance with article 4 of the Energy Efficiency Directive of the EU. This article obliges states to define strategies in order to mobilise investment in the renovation of national building stocks. The BPIE report doesn't comment on the tangible progress that is being made 'on the ground', but it shows that in Spain at least the analysis of problems and definition of possible solutions for those problems is fairly advanced.

So there are positive developments to be mentioned, although they are until now mainly to be found in academic spheres and preliminary actions. The context of architecture might give us hope that the profession in Spain will be able to re-define itself, finding a new legitimacy for architecture. Very important will be obviously the attitude of the architects themselves towards this new situation, as being free exercising professionals. Here we have to admit that too many architects may be aware of the problems, but in their daily practice they show little entrepreneurial spirit or visionary action. They stand petrified when asked for their personal contributions and tend to insist in classic public architecture competitions or traditional relationships with private developers, although the majority of work may very well be of a radically different nature than before.

Conclusion

It is paramount that Spanish architects try to define for themselves a comprehensive theoretical framework and practical business-model, addressing the new situation within which they will have to exercise their profession. It will need to take into account the company that produces building elements, the user that turns the climatization on and off (or opens a window) and the developer that might be exactly the same person that suffers the consequences of difficult building maintenance. If this doesn't occur the lack of social legitimacy of architecture in Spain will install itself permanently.

The fact that most of the shifting paradigms are related to sustainability, in our profession understood as a scarcity of resources and the satisfaction of social necessities, indicates clearly where to search for such a coherent, transversal and at the same time rigorous, conception which might be the base for a new relevance. The architect is offering his services in a market that has transformed and the added value of his intervention has to be clear and recognised by his clients. At the same time the architect, as a provider, has to be competitive in doing so. Not only the economic legitimacy of the profession will arise from his understanding, in all its aspects, of the phenomenon of sustainability, but this will also be what gives relevance to the fact that architecture is being produced. It is the only way to make sure that architecture in Spain will make sense in the future.

Endnotes

[a]The book stands out for rigorous documentation of Eastern European architecture in the twentieth century, a field that was largely neglected by many architecture-critics of the modern epoch.

[b]A survey of the Spanish Architects Labour Union over the year 2013 indicated that 71% of the architects in the country were either without work or earning less than 1.000€ a month. http://www.sindicatoarquitectos.es/descargas/iii-estudio-laboral-arquitectura-sarq-2013.pdf.

[c]The two-day seminar, organised by Architects Association *Arquitectes per l'Arquitectura* and ceramics company ROCA, consisted of four sessions, dealing with Communication, Energy, Re-utilisation and Economy. Speakers were amongst others Serbian Industrial Engineer Alex Ivancic, former prime minister of the Netherlands Ruud Lubbers, Clean tech entrepreneur Warner Philips and present director of the Green Building Council España, the Belgian architect Bruno Sauer. The author of this article collaborated in the event as discussion moderator.

[d]The WSB14 was the latest in a series of world-wide Sustainable Building conferences, repeating every three year, being organised by World green Building Council, IISBE (the International Initiative for the Sustainable Built Environment) and UNEP (United Nations Environmental Program), amongst others. The three day event united 2172 attendees (39% from Spain, 61% from abroad) gathering for a total 145 sessions. The next WSB will be held in 2017 in Hong Kong.

[e]This document was an initiative of the European Climate Foundation and it pretends to mark possible ways to realise in 2050 a 'low-carbon economy' in the European Union, meaning that by 2050 the reduction of CO2 emissions would be 80% compared to what they were in 1990. http://www.roadmap2050.eu/.

[f]While diversifying regionally, Sustainable Building Tools (SB-tools) around the world are at the same time constantly updating their appreciation of the consequences of design

decisions. Recently LEED v4 was launched, tightening requirements but also broadening its scope, including specific evaluations for more different typologies.

[g]Although the European 2010/31/EU directive on the energy performance of buildings says that at the end of 2018 all public buildings should be 'near-zero energy buildings', the definition of 'near zero-energy buildings' in that same directive is that they have a 'very high energy performance' and that the 'energy required should be covered by a very significant extent by energy from renewable sources'. These inexact quantifications leave margins, that might end up being considerable. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF.

[h]In June 2014 the region Parkstad started an IBA-competition (International Bau Ausstellung), adopting the frame work that had been used before in Germany, to try to tackle with architectonic/urbanistic proposals some of the problems that the region is struggling with. The brief asked for ideas that could enhance quality of life within a decreasing demographic context. Architect-urbanist and professor at the polytechnic University of Delft, ir. Jo Coenen was appointed as director of the IBA-Parkstad office. The first entry of proposals has taken place in December 2014 and the process is due to finish in 2020. http://www.iba-parkstad.nl/nl.

[i]It was in an informal conversation with the author of this article, in the margins of the seminar *'The Context of Sustainable Architecture'*, that Hans Ibelings recognised that the 'loss of importance of architecture' that he signals in his book might be specifically in the field of cultural relevance, while on the socio-economic level it might be a different story.

[j]From an etymological point of view the word 'integrated' expresses better the possibility of recuperation than the word 'incorporated', where the association with a body, 'corpus', might seem contradictory to the idea of taking back some part of it. This reflects the changing perception of a building as a technological phenomenon.

[k]For more on the collateral damages that were caused by the real estate bubble and its eventual explosion, the document 'Ruinas Modernas' made by the German architect Schulz-Dornburg analyses with relentless rigor the many times un-legal creation of new urban areas. It shows the tremendous damages inflicted on the landscape as a consequence of the absurd and perverse processes of land-development that took place in Spain after 2000. Ruinas Modernas, una topografía de lucro - Julia Schulz-Dornburg, editorial Àmbit 2012.

[l]The administrative organisation of the Spanish state is basically split in three levels: national/regional/municipal. The competences that each of these layers has regarding urban planning and construction regulation make a coherent implementation of sustainablity policies a very complicated issue.

[m]A clear theory on the socio-economic resilience of cities and, by consequence, of their environmental sustainability, is to be found in the work of the economist and Harvard professor Edward Glaesser, especially in his book Triumph of the City, editorial Macmillan 2011.

[n]This SB-rating tool takes into account Spanish regulations and conditions and was elaborated under guidance of architect Manuel Macias, professor at the Polytechnic of Madrid and has been launched on the market in recent years.

[o]Another serious point of critique towards LEED that is reflected in VERDE is the fact that LEED awards the 'sustainability' of building, no matter the costs of achieving this. This tends to make 'sustainable building' a thing that is within reach of the wealthy, while leaving out the bulk of construction, which is bound by tight budgets like social housing. This 'exclusiveness' is in some way countered by the criteria for 'Social and Economical Aspects' that VERDE introduces. It's most explicit expression is evaluation point F08: Construction Costs. It rewards as 'best practice' a price that stays about 5% below the average of national construction costs. http://www.gbce.es/archivos/ckfinder/590files/GEA%20VERDE%20NE%20RO%20V%201c.pdf.

Competing interests
The author declares that he has no competing interests.

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